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ABSTRACT

Research on interactive thinking has revealed that teachers make interactive decisions in response to students' behavior and to the flow of the activities or routines they have established based on their planning. The purpose of this study was to describe the interactive information processing of preservice teachers, and to identify similarities and differences among the interactive thoughts and decisions of elementary and secondary preservice teachers. Twenty undergraduate student teachers participated in the study. During the final weeks of student teaching, the subjects were videotaped conducting lessons of their own design and then responded to stimulated recall interviews while watching the tapes. The results of the study indicated that each group reported more pupil-related decisions than any other type. However, there were differences in the patterns of emphasis in the types of interactive decisions of the participants. Elementary teachers placed a dominant emphasis on pupil-related decisions, while secondary teachers were more content-oriented. The findings from case studies provide a close look at the interactive thoughts and decisions of two exemplary student teachers. Charts illustrate patterns of interactive thinking, and appendices contain descriptions of the interview procedure and coding system used in the study. References are included. (JD)

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DIVINING AND DEFINING A PROBLEM SPACE: AN INVESTIGATION OF PRESERVICE TEACHERS' INTERACTIVE THINKING

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Over the past fifty years, researchers have formed different research questions and used a variety of methodological procedures to answer the overall question which guides research on teaching: What makes an effective teacher? An underlying assumption of this research is that answers to this question can be used to train preservice teachers and to improve the teaching of inservice teachers.

Early research on teaching focused on presage variables. However, the findings from this research only characterized teachers perceived to be effective and there was no evidence gathered to indicate that teachers who had these characteristics were more effective than teachers who did not. Medley (1979) has argued that "what a student in a preservice teacher education program needs to learn is not what s/he should be but what s/he must do in order to be effective" (p. 13).

The discovery of what teachers do is the goal of process-product research. Correlational (e.g., Evertson, Anderson, Anderson, & Brophy, 1979 and Good & Grouws, 1977) and experimental (e.g., Anderson, Evertson, & Brophy, 1979 and Good & Grouws, 1979) studies have provided information linking teacher behaviors to student outcomes. This information is often addressed in teacher education programs. However, Brophy (1980) has suggested that process-product research can

> inform teachers about the probable outcomes of their decisions [to use certain behaviors] but cannot make those decisions for them....Thus, although teaching can and should become much more of a data-based applied science than it is now, it will always remain at least partly a clinical profession involving planning, judgement, and decision making. (pp. 23-24)

Thus, attention to only the overt behaviors of teachers does not seem to be enough.

In 1968, Jackson described life in classrooms with an emphasis on the "hidden" side of teaching and argued for the importance of understanding the thinking and planning of teachers. In 1973, Shavelson suggested that "any teaching act is the result of a decision that the teacher makes after the complex cognitive processing of available information" (p. 149). This conceptualization of teacher as decision maker had, in Shavelson's view, implications not only for research but also for teacher education. In 1974, Panel 6 of the National Institute of Education (NIE) Conference on Studies in Teaching called for research which emphasized teachers' cognitive processes, stating that "what teachers do is directed in no small measure by what they think" (p. 1). In 1975, NIE issued a request for proposals for an Institute for Research on Teaching that would focus on research on teaching as clinical information processing.

As a result of this request, the area of research known as research on teacher thinking developed rapidly. Research on teacher thinking in the past decade has focused on two main areas: teacher planning (preactive and postactive thoughts) and

teachers' interactive thoughts and decisions.

In regard to teacher planning, research shows that teachers are less concerned with the structure of the subject matter they teach (Schwab, 1962; Shavelson, 1972) than with the selection of activities to use (Clark, 1978-1979). The research also indicates that student ability is considered important information when teachers plan lessons (Borko, 1978; Cooper, Burger, & Seymour, 1979; Morine-Dershimer, 1979; Shavelson, Cadwell, & Izu, 1977).

Research in the area of interactive thinking indicates that teachers continue to make decisions as they teach a lesson (Clark & Peterson, 1984). This research also reveals that teachers' plans act to guide their interactive teaching (Abelson, 1976; Morine-Dershimer, 1979), that teachers make interactive decisions in response to students' behavior (Connors, 1978; MacKay, 1977; MacKay & Marland, 1978) and to the flow of the activities or the routines teachers have established based on their planning (Joyce, 1980; Morine & Vallance, 1975; Peterson & Clark, 1978).

Conceptual Framework

Cognitive psychology is the basis for research on teacher thinking. Drawing from information-processing research in fields other than teaching and from a series of studies on teachers' information processing, Joyce (1980) has suggested a "theory of information processing in teaching." His theory suggests that interactive information processing can be seen as a series of overlapping dimensions.

According to Joyce, teachers' information processing begins with the flow of cues from students. These cues are numerous and are not independent of the tasks given to students by the teacher. Furthermore, the teacher may perceive all or none of these numerous cues. Thus, the first stage of information processing is the teacher's perception of the available cues. However, the perception of cues is not simply a mechanical process but requires that the teacher interpret the cues. Interpretation is also not a mechanical process and may be subject to a certain amount of distortion. Next, based on the teacher's interpretation, the cues are processed for "relevance to the teacher's field of concern". These fields of concern feed into and influence the teacher's response behavior (decision). This whole process allows teachers to simplify their environments and define a problem space.

In his book The Reflective Practitioner, Schön (1983) has distinguished between problem-setting and problem-solving. His description of problem-setting seems similar to Joyce's theory of information-processing. Schön states,

> When we set the problem, we select what we will treat as the "things" of the situation, we set the boundaries of our attention to it, and we impose upon it coherence which allows us to say what is wrong and in what directions the situation needs to be changed. Problem setting is a process in which, interactively, we name the things to which we will attend and frame the context in which we will attend to them. (p. 40)

Statement of Problem

While research has provided information on the interactive thoughts and decisions of inservice teachers, there has been little research on the interactive thoughts and decisions of preservice teachers (e.g., Chi, Glaser, & Rees, 1981). In addition, the research that has been conducted seems to suggest that there may be differences between the interactive thoughts and decisions of inservice teachers and preservice teachers (e.g., Fogarty, Wang, & Creek, 1982; Morine-Dershimer et al., 1983).

The majority of the subjects in the research on teacher thinking have been elementary (Kindergarten through sixth grade) teachers. There has been little research on the interactive thoughts and decisions of secondary (seventh through twelfth grade) teachers. It has been suggested however, that there may be differences between the thoughts and decisions of elementary teachers and those of secondary teachers (e.g., Brophy, 1983).

Using Joyce's conceptual model (graphically represented in Figure 1) as a framework, one purpose of this study was to describe the interactive information processing of preservice teachers. That is, to describe what available cues (shaded area) preservice teachers perceive and interpret as having relevance to what fields of concern (four corners of inner circle), how these concerns relate to each other or vie for the teachers' attention (double arrows) and influence what type of decisions (single

arrows) thereby defining a problem space (inner circle).

In addition, a second purpose of this study was to identify similarities and differences among the interactive thoughts and decisions of three subgroups: elementary, secondary, and dual preservice teachers. A third purpose, although not reported in this paper, was to describe the sources of knowledge that preservice teachers use to aid their interactive thoughts and decisions (outside rectangle).

Methodology

Subjects

The subjects for this study were twenty undergraduate education majors who were student teaching in suburban, public schools during the 1983-84 academic year. Of these twenty subjects, six were elementary education majors (all females), six were secondary education majors (three males, three females), and eight were "dual majors" (one male, seven females). While dual majors have not been separated as a group in other research studies, the difference in their teacher education programs at Syracuse University seemed to warrant the formation of a separate group.[1] However, because of time and space limitations, this paper reports only on the elementary and secondary majors.[2]

Procedure

During the final weeks of the student teaching experience, the subjects were videotaped conducting lessons of their own design. Following the lesson, each subject viewed the videotape and responded in a stimulated recall interview, a technique adapted from the South Bay Study (McNair & Joyce, 1979; Morine-Dershimer, 1979). (See Appendix A.) Throughout the interview an audiotape recorder was used to pick up the subject's responses. Thus, verbal reports from the stimulated recall interviews formed the data base for this study.

Analyses

Three types of analyses were conducted on the data base. First, each interview was transcribed and a categorical analysis was conducted using the system proposed in the South Bay Study (Morine-Dershimer, 1979) and later adapted for use in a study of secondary preservice teachers' interactive thoughts and decisions (Morine-Dershimer et al., 1983). The system contains four major categories: 1) decision point--the kind of decision, or nondecision, that the teacher is reporting; 2) concern--the elements related to pupils, content, procedures, or pacing that command the teacher's attention, i.e., that the teacher reports noticing; 3) information source--the types of input/cues that the teacher indicates s/he is alert to during the lesson; and 4) awareness--the varieties of cognitive and affective responses that the teacher mentions experiencing during the lesson. Each

major category has several sub-categories. (See Appendix B for categories and examples.)

After two judges coded the interview protocols (intra- and inter-rater agreement >.85), proportional frequencies of comments made about the lesson were calculated for each category for each subject using the following formula:

$$\frac{\text{Number of events in which a particular category is referred to}}{\text{total number of events discussed (i.e., times the videotape was stopped)}}$$

Means for each category were calculated for the total group of subjects, then separately for the three subgroups. Using these proportions, profiles were constructed for individuals and for groups, providing graphic displays of the preservice teachers' patterns of attention.

In order to further describe the patterns of distribution of attention across categories, the proportional measures for all twenty subjects for all categories were used to determine an overall mean and standard deviation. These measures were used to identify levels of proportional frequency indicating that categories were "pertinent", "important", or "dominant" in a preservice teacher's thinking.[3] These distinctions were used to indicate the focus of preservice teachers' interactive thoughts and decisions and to compare the patterns of emphasis of the three subgroups of preservice teachers. In a similar way, an overall group mean and standard deviation were computed for each

subgroup separately and these measures were used to examine individual differences in patterns of emphasis within each group.

Two non-parametric tests were used to determine the similarities and differences in interactive thoughts and decisions among elementary, secondary and dual preservice teachers. The Friedman two-way analysis of variance by ranks was used to determine whether attention was distributed randomly across the four major categories of thinking. A two-tailed Mann-Whitney U test was used to determine whether there were significant differences among the three subgroups in the degree of attention given to a particular sub-category of thinking. Specific categories to be tested were determined primarily on the basis of prior research findings suggesting potential differences in the perceptions of elementary and secondary preservice teachers. In addition, where findings of this preliminary study showed meaningful differences in patterns of attention, tests were run to determine whether the differences were statistically significant. Significance was established at the .05 level.

After the quantitative analysis was completed, one subject in each subgroup who most closely represented the general patterns of the subgroup was chosen for a case study. The interview protocols for each exemplary subject were analyzed further to more fully describe the interactive thoughts and decisions of these three preservice teachers. The case studies were seen as a way to enrich the quantitative data and as a way to address the

components of the conceptual framework used in this study.

Categorical and Quantitative Results

Preservice Teachers

In general, the results of the categorical and quantitative analysis (Table 1), placed within the conceptual framework of the study (Figure 2), indicate that two sources of information received emphasis as preservice teachers attempted to simplify their environments. Observations of pupils' verbal behavior were important sources of information and information recalled from past experiences with their students was a pertinent source of information.

These cues were interpreted as having relevance to three fields of concern: procedures, pupils, and content. Specifically these information sources were related to their dominant concern about instructional procedures and to their pertinent concerns about pupil learning, pupil behavior, informational content and management procedures. In this way, they tended to define the problem space in terms of procedures, pupils, and content.

In addition, the findings indicate that as a result of their information processing, these preservice teachers placed a dominant emphasis on pupil-related decisions and a pertinent emphasis on plan-related decisions and explanation of events. They reported almost no supplementary decisions. They also placed an important emphasis on an awareness of alternatives

which could be used during their interactive teaching.

Subgroups

The results of the categorical and quantitative analyses of interactive thoughts and decisions of the two subgroups add to this general description by indicating similarities and differences among elementary and secondary preservice teachers (Table 2 & Figure 3). In addition, the Friedman two-way analysis of variance by ranks indicated that categories of reported thinking were significantly different (range $p<.001$ to $p<.05$) in the amount of attention they received, but subjects within subgroups (e.g., elementary education majors) were not significantly different in the patterns of attention they displayed.

The two groups of preservice teachers were similar in the sources of information they emphasized during their lessons. An important source of information for both groups was their observations of pupils' verbal behavior. In addition, a pertinent source of information was the information which they recalled from past experiences with their students. Although both groups used similar sources of information during their lessons, each group simplified and defined their problems spaces somewhat differently (Figure 4).

Elementary Preservice Teachers. The elementary preservice teachers had two fields of concern above the threshold of attention marked by the mean. These included a dominant emphasis

on concerns about instructional procedures and a pertinent emphasis on concerns about pupil learning. While pupil-related pacing was not a heavily emphasized area of concern for elementary preservice teachers, they did mention this type of concern proportionately more often than did secondary preservice teachers. This difference approached significance ($U=7$, $p<.09$). Thus, elementary preservice teachers had a narrowly defined problem space.

Secondary Perservice Teachers. The secondary preservice teachers emphasized four fields of concern. Included in their procedural field of concern was a dominant emphasis on concerns about instructional procedures. Their pupil field of concern included a pertinent emphasis on concerns about pupil learning. Thus, the secondary preservice teachers were similar to the elementary preservice teachers. While pupil attitude was not a heavily emphasized area of concern for secondary preservice teachers, they did mention this type of concern significantly more often than elementary preservice teachers ($U=4$, $p<.026$). Furthermore, they were significantly different from the elementary preservice teachers in that they placed a pertinent emphasis on informational content ($U=4$, $p<.026$). In addition, they were significantly different from elementary preservice teachers in that they placed a pertinent emphasis on plan-related pacing ($U=4$, $p<.026$). Thus, secondary preservice teachers had a more broadly defined problem space than the elementary preservice teachers.

The results of the study indicated that each group reported more pupil-related decisions than any other type of decision (Figure 5). However, there were differences in the patterns of emphasis in the types of interactive decisions of elementary and secondary preservice teachers. Elementary preservice teachers were the only group to place a dominant emphasis on pupil-related decisions. This difference approached significance ($U=6.5$, $p<.07$).

In addition, both groups reported an awareness of alternatives which they could use during interactive teaching. However, secondary preservice teachers placed significantly more emphasis on principles of teaching than did elementary preservice teachers ($U=5$, $p<.03$). They also placed significantly more emphasis on awareness of teacher behavior than elementary preservice teachers ($U=4.5$, $p<.02$).

Case Studies

The findings from the individual case studies provided a closer look at the interactive thoughts and decisions of three exemplary preservice teachers. An attempt was made to choose the subjects who most closely represented the general patterns of interactive thoughts and decisions from each group. The results of the case studies indicated that each preservice teacher seemed to be juggling several instructional concerns and in that juggling defined their problem space.

Linda: Elementary Preservice Teacher

Linda had planned a concept attainment lesson (Joyce & Weil, 1980) to teach rhyming words to a small group of first grade pupils. Her four pupils, Ann, Evan, Patty, and Jean were seated in front of a chalkboard at the back of the classroom while the rest of the class was engaged in seatwork activities. Linda had prepared a set of cards containing pictures of items that rhymed, as well as a set of cards containing pictures of items that did not rhyme. Underneath each picture she had written the word for the picture.

As the lesson began, Linda explained to her pupils the purpose of and procedures for the lesson. She told the pupils that they were going to play a guessing game that they had played before. She explained that she would show them some pictures. If the picture was an example of her idea, she would put it under "yes" on the chalkboard. If the picture was not an example, she would put it under "no" on the chalkboard. She asked them to look at the pictures carefully to see if they could tell her what it was that she was thinking about. She also told them to raise their hands, not call out, if they thought they knew the answer. In discussing her interactive thoughts and decisions for this event, she commented on her concerns about pupil learning and behavior as well as her concerns about procedures for management and instruction.

> The reason that I said that was because some of the children, I thought, may have already known the concept

> of rhyming and I realized that others didn't. I made that decision before we started because sometimes they are so quick to jump to try to figure out what a concept is that they don't really look at it [the examples]. And it is a game, but at the same time, I don't want it to be a big guessing game.

It is interesting to note that, except for this plan-related decision and one supplementary decision, all the rest of the decisions which Linda reported were pupil-related. It is also interesting to note that, as with this plan-related decision, information recalled from her past experiences with these four pupils, her expectations, and her observations of pupils' verbal responses were the major sources of information for Linda's interactive thoughts and decisions. In addition, throughout the lesson Linda emphasized concerns about pupil learning and procedures for instruction.

After presenting two words that rhymed, Linda was interrupted by a telephone call. When she returned to the group, she reviewed these examples and presented a word that did not rhyme. In discussing her interactive thoughts and decision for this event, she commented,

> I repeated them, "c-a-n and p-a-n", stressing that they were rhyming words. But that's also the way that they learn to read the word. I want them to eventually be able to see the reason why <u>-an</u> words are in the same column. I had lost the momentum that was being established. I thought if I bring them back by repeating the words, it may make it easier for them to notice the pattern, than simply going on.

Linda still had concerns about pupil learning and her procedure for instruction but she now also had a concern about content, related to the abilities of the pupils to "notice the pattern",

their thinking skills, and a management concern which was caused by the interruption.

Linda continued by presenting another positive example of a rhyming word (fan) and asked if anyone thought they knew what her idea was. Evan raised his hand and said that all the "yes" examples (can, pan, and fan) were made out of metal. The interviewer stopped the videotape at this point and Linda commented,

> That was a clever answer. I was very impressed. It wasn't the answer I wanted, but I purposefully wanted to praise him for his answer.

In commenting on her feelings about Evan's clever, yet incorrect answer, Linda's attention was on her instructional procedure.

Next, Linda told the pupils that she would give them a hint and said, "It's something about the words." Before she could present another example, two students called out that they knew what she was thinking about. She commented,

> I wanted to show another example because I didn't think that Ann and Evan knew what it was yet. I realized that Evan was looking at the pictures not the words as much. Ann usually is very quick and she hadn't said anything. So I wanted to give them a little more time.

In this event, Linda's concern about pupil-related pacing was related to her concerns about pupil learning and procedures for instruction.

Linda then presented two words that did not rhyme (jam and hat) and asked the pupils to look at the "yes" examples and tell her

what was the same about all of them. After some discussion, Ann said that all the "yes" words ended in the same letters and Patty said that they all rhymed. Linda told the pupils that they were correct and that rhyming words was her idea. She presented another rhyming word (man) and then changed her instructional procedure. At this point she commented,

> I wasn't able to really tell if they had a reason for why the words rhymed or if they understood why the word" rhymed. So I decided to have them tell me where it should go so that I would be able to evaluate if they understood it. I almost changed to a bingo game that I had...but I thought that transferring it over would be too complicated. I liked the way it [the lesson] was going. I felt they were learning from it. I also thought about asking <u>them</u> to think of words that rhymed, but I decided not to because I was pressured for time and I wanted to evaluate to see if they were able to determine which category the pictures went with.

In this event, Linda's concern about plan-related pacing was related to her concerns about pupil learning and to her choice of alternative instructional procedures.

Linda presented the examples of cat and ran using this new instructional procedure. When Evan pronounced r-a-n as run, Linda commented,

> See he told me just the ending sound was the same and he was only looking at the end. They are right out of a linguistics program and they are learning that the main part is the first two letters and the ending sound is only the last letter. I don't want to confuse them. So I just have him go back and read the word for me, that's enough. I wasn't pleased with the way that the concept had been defined, as just the ending sounds [last letter], because it's more than just the ending sound.

In this event, Linda's concern about informational content was

related to her concerns about pupil learning and to her choice of an alternative instructional procedure.

After the pupils had identified the last two words (hat and bat) as non-examples, Linda had the pupils read the cards which she had placed under the "no" column on the chalkboard. At this point she commented,

> When I made the cards I chose cat, cap and can because they [the pupils] are so accustomed to looking at [the first] two letters that I thought they would tell me that those rhymed, but they didn't. Then I noticed that cat, bat, and hat all rhymed. That wasn't intentional.

Based on this unanticipated circumstance, she made a supplementary decision. Her comments continued,

> So I decided to have them look at the no column and find the three words that rhymed. I had stressed so much that the rhyming word was -an, I thought that they could have left my lesson thinking that rhyming words only end in -an and then that would have been very confusing.

This supplementary decision was based on information from the words in the "no" list and on Linda's assumption, and she was still concerned about pupil learning and instructional procedures.

Evan and Ann identified two of the rhyming words in the "no" list and then Linda called on Jean. She commented,

> Jean looked puzzled. I didn't know if she was puzzled because she didn't understand or her mind was just on something else, but I wanted to see if she was able to understand it so far. That's why I specifically made the decision to call on her. I stayed with her for a while because she is still learning the sounds of each letter.

Again Linda's concern about pupil-related pacing was related to her concern about pupil learning and her choice of an instructional procedure; all of which were based on information processed from her observation of Jean's non-verbal behavior.

After Jean identified the third word, Ann said that there were two more rhyming words in the "no" list and Linda asked her what they were. Again Linda commented on her concerns about pupil learning, procedures for instruction and plan-related pacing.

> I could have just said, "No, there aren't, Ann, because look" but I wanted her to look and find out for herself and to see why, and she did. I wanted to do the game at that time, but because we have four reading groups in the morning, I could only keep them a little longer.

After this event, Linda ended the lesson with a written task on rhyming words.

As the previous excerpts indicate, Linda had a strong awareness of alternative instructional procedures which she could have used. However, because she had chosen a teaching strategy which has prescribed procedures, she felt a need to follow those procedures. At one point during the interview, she commented,

> I didn't think about probing them a little longer because what I learned in Strategies [an education course] had to do with the concept attainment model. We learned only to take yes or no and try to move on before you get to the concept and then go back and formalize what the concept is. So I'm trying to stick to the strategy as much as possible. Another reason why I don't want to probe too much and tell it to them is that one of the objectives for the concept attainment model is to help them classify things by looking and observing. So I'm trying to do that.

However, her concerns for pupil learning seemed to have a stronger influence on her choice of instructional procedures than her need to "stick to the strategy." Her comment continued,

> Even now I'm moving away from it. I felt maybe too much, but not too much for what they [the pupils] needed.

Linda was trying to balance the need of her students with the prescribed procedures of the teaching strategy she had chosen. Her concerns about her pupils' needs influenced her choice of alternative instructional procedures. She was juggling concerns about pupil learning and concerns about instructional procedures, and these two fields of concern fed into her pupil-related decisions. Thus, her problem space was defined as pupils and procedure (Figure 6).

Greg: Secondary Preservice Teacher

Greg was teaching a unit review lesson in Earth Science. His twenty-five, ninth grade pupils were seated at lab tables with a clear view of the chalkboard and projections from an overhead. Greg used both of these throughout the lesson to display information. The students had been assigned a review sheet as homework and the lesson proceeded with Greg asking questions from this sheet. He commented on the general procedures for the lesson when he stopped the videotape the first time.

> Pretty much all the way through, I tried to mix asking and letting them answer and asking and pointing to a certain person. This is like a review and I kind of want to make sure that everybody gets a chance to answer at least one [question].

Then two stops later one of his comments seemed to give some insight into what he saw as the general purpose of this lesson.

> Well, getting the material across to the students. On the way, I want to evaluate, see if they can really give me what I am looking for and make sure they know this material. It is kind of a feeling-out process.

In this review lesson, Greg reported concerns about pupil learning and he mentioned teaching principles which he used related to this concern.

> It's a review and I think they get more out of it if they are answering the questions and I probe the students than if I just sit up there and give it all to them. I wanted to get them to relate it to what they did in the classroom, how they came about answering or discovering. That is a good way of remembering.

Greg's concerns about informational content were closely related to his concerns about pupil learning and instructional procedures. He wanted more than rote memorization and his concerns about procedures for instruction were often related to guiding his students to higher levels of understanding. Throughout the lesson he commented,

> I thought they should know the steps [for the greenhouse effect] because that was on the test. What is the greenhouse effect?--that's like a higher level question. I wanted to see if the students understood it. I didn't want rote memorization feedback kind of answers. When I didn't get it, I waited. Nobody volunteered. So to help jog their memory I was thinking, if I could kind of hint that they were given steps [in a previous class] then maybe they would remember the steps and maybe they could think of putting it into their own words.

Greg was not only concerned that his students had the correct understanding of the informational content, he was also concerned

about content related to the students' abilities to determine how to "get the correct answer." This concern was also closely related to his concerns about pupil learning and instructional procedures.

> I was talking about using the electro-magnetic spectrum chart, and since some of the answers were coming from that, I left it up. I wanted them to see that this is what you use. I told them that they were going to have one given to them for the exam. I wanted them to know that that is where the answers were I wanted them to know what to look for and how to interpret some things from the chart.

Greg was also concerned with the pacing of the lesson. As the following comments show, his plan-related pacing concerns were complicated by his concerns about pupil learning. In addition, his choice from alternative instructional procedures often seemed to be related to this conflict.

> I had examples of these angles on another overhead and that decision was...Should I go back and show them these other overheads or show them other examples that are in the room? I guess there I thought, no, I shouldn't go back. Time is not going to allow me to do that so I have to do it as best I can right here without finding something else, as long as I get the feeling that they understand.

> I'm being conscious of the time right there. We still had a lot of questions to cover. At that point, unfortunately, getting through it all was more important than making sure everyone understood.

Greg made an interesting comment in which he differentiated between his information sources during review lessons and his information sources during lessons where he would be presenting new information.

> A lot of it [information source] is what I had seen from before, because this is material we have gone over

> and I've seen where the pitfalls have been. I know where some of the weaknesses are ahead of time. [In] a class where I would be presenting new material, decisions would be made a little bit differently, I think, because it's new and my decisions would be based on student reactions, I think, more.

This statement seems to indicate that Greg was using previous information about his pupils' knowledge or lack of knowledge to guide his interactive thoughts and decisions. The statement also supports his earlier statement about the purpose of the lesson as well as his emphasis on concerns about pupil learning. However, when he discussed particular events in the lesson his information processing seemed to be focused more on immediate observations. There was only one event where he made explicit reference to his "knowledge of where the students had problems."

> Okay, there was a decision here. I slowed down, made sure I covered the whole thing in depth as if it were new material. There was nothing going on in the class that made me stop and decide that. It was just previously knowing that a lot of students had missed it.

Most of Greg's pupil-related decisions were based on information which he processed from observations of either pupils' verbal or non-verbal behaviors. For example, the incorrect verbal response of one student resulted in instructional concerns as well as concerns about the pupil's attitude.

> He gave me an answer that wasn't what I was looking for. I don't want him to feel bad because he is wrong but then again I want another answer so I am probing for another answer. I think that is better than to say, "No, you are wrong" and ask somebody else. That turns a student off. So that is consciously a decision as to how to reply to an answer that is not the one you want.

Greg's attention to non-verbal behaviors seemed to provide cues for his concerns about pupil learning and procedures for management.

> Carl is shy. I saw him raise his hand, so I finished what I was writing. He had dropped his hand but he is a pretty smart student and any question that he has would probably be good for the rest of the class to hear, so I made sure I went back to him.
>
> Connie was sitting with her head down. I asked her [a question] specifically to see if she was with us. She didn't know the question and she didn't know the one we had just gone over. I go over there to look at her paper and she doesn't have one. I tried to get her another one but there weren't any out. So it was like, whoops, I was stuck. She is not going to get it because she is not writing it down. I didn't know where to find anymore. It would have been a big loss of time [to find one] so I continued on.

Greg was trying to balance his concerns for his students' level of understanding (pupil learning) with his plan-related pacing concerns. His concerns about instructional procedures and his choices among alternative procedures were often related to this conflict. He was juggling these three fields of concern which were vying for his attention. Thus, pupils, procedures, and pacing fed into his pupil and plan-related decisions and defined his problem space (Figure 7).

Discussion

This study examined the relatively unexplored area of preservice teachers' interactive information processing. The findings support the explanatory power of Joyce's information-processing model for preservice teachers. The

categorical and quantitative analyses identified the specific dimensions of the model, that is, the cues that preservice teachers perceived, the concerns to which they attended, and the decisions they made. The case studies enhanced the quantitative findings and described the interaction of the various dimensions, that is, how preservice teachers interpreted and processed the cues as having relevance to certain fields of concern, how they balanced these fields of concern in an attempt to simplify and define a problem space, and what decisions they made, from alternatives, that helped to maintain the balance.

At each level of analysis, the findings present teacher educators with an encouraging picture of preservice teachers' interactive thoughts and decisions. Preservice teachers perceived and interpreted information from their pupils (both immediate observations and recalled information), attended to the needs of their pupils, were aware of alternative instructional procedures, and were able to report decisions which they made. These preservice teachers were clearly aware of processing information during their interactive teaching.

Group differences in defining a problem space tended to reinforce the stereotypic beliefs about the inherent differences between secondary and elementary teachers. Secondary preservice teachers were more content-oriented, as evidenced by their greater emphasis on informational content and plan-related pacing. Elementary preservice teachers were more pupil-oriented, as evidenced by their greater concern for pupil-related pacing.

Group differences concerning the complexity of the defined problem space raise questions about the instructional effectiveness of these preservice teachers. Although not addressed in this study, Morine and Vallance (1975) found that less effective experienced teachers (defined as teachers whose students had lower gain scores on an achievement test) reported having more things in mind as they discussed their interactive decisions. Thus, one might speculate that preservice teachers who define their problem space broadly (e.g., secondary preservice teachers) may be less effective than those who define their problem space more narrowly.

The complexity question may also have implications for the development and improvement of the teaching skills of preservice teachers. For example, attention on too many aspects within a lesson, as with the secondary preservice teachers, may result in fragmentation. That is, the preservice teacher may have difficulty focusing on any one aspect of his or her teaching in order to develop and improve that aspect. On the other hand, attention to only a few aspects within a lesson, as with the elementary preservice teachers, may result in limited development. That is, the preservice teacher may concentrate on the development and improvement of only a few teaching skills to the exclusion of others. It is important to note that this study sampled only one lesson, therefore, one can not assume that the patterns of these preservice teachers' interactive thoughts and decisions are the same for every lesson they teach.

It is interesting to note that the findings of this study are similar to the findings from past research on inservice teachers. Even with the differences among elementary and secondary preservice teachers, the main foci of preservice teachers' interactive thoughts and decisions were on their pupils and their instructional procedures. It seems logical that preservice teachers would focus on their instructional procedures since they are still learning these procedures (Fuller, 1969). However, this finding must be interpreted within the context of the study. The participants of this study were student teachers who were evaluated on their performances. This context presents an alternative explanation for the emphasis on concerns about instructional procedures.

An interesting difference between the findings of this study and the findings from past research on inservice teachers is that these preservice teachers considered more alternatives than inservice teachers. One explanation is that preservice teachers may not have established teaching routines. Another explanation is the teacher education programs of the subjects. The programs are organized around the theme of "teacher as decision maker" which emphasizes building a repertoire of teaching strategies and thereby having alternative instructional procedures.

For teacher educators, the findings of this study emphasize the fact that preservice teachers are in the initial stages of developing the skills of teaching. They are also developing

values and attitudes. If one believes that pupils should be a focus of the teacher's attention, then one should be encouraged by these findings. If one believes that part of learning to teach is a process whereby an individual thinks about what he or she is doing, what Schön (1983) calls "knowing-in-action", then one should also be encouraged by these findings.

This study is only a beginning. Studies are needed to expand and refine the descriptions from this study and to increase the generalizability of the findings. Such studies could sample more than one lesson to determine whether preservice teachers' patterns of emphasis on instructional concerns persist over time, influence their effectiveness, or influence the development of teaching skills.

Studies could be conducted as preservice teachers begin their early field experiences. The findings from these studies could then be used for evaluation and improvement of teacher education programs. The findings might also be useful for the development and improvement of an individual preservice teacher's interactive teaching. Studies of preservice teachers from other institutions are needed to examine program differences in preservice teachers' interactive thoughts and decisions.

A longitudinal study utilizing the same subjects in their first, third, and fifth year of teaching would provide information on changes in patterns of interactive thoughts and decisions. Such a study could provide information on the

continued effects of teacher education programs and possibly inservice education programs.

While the collective data from this study provides evidence about general patterns of preservice teachers' information processing, the video-taping and interview used for data collection may provide individual opportunities for preservice teachers to reflect on their own behavior, to engage in what Schön (1983) has described as "reflective practice." For as Greg commented,

> I can think about it now, but I'm not sure I'm thinking about all of this as I'm doing it (teaching). When I sit back, I can think of things that help.

Thus, researchers, teacher educators, and preservice students might all learn together from future studies of this nature.

NOTES

1. The dual majors included four early childhood education majors, who fulfill requirements in the School of Education and the College of Human Development; two subjects who were obtaining certification in both special education and elementary education; and two subjects who were taking courses in both elementary and secondary education, thereby receiving N-9 certification in social studies.

2. Fictitious names were assigned to the subjects and their pupils, however gender was accurately represented.

3. Categories with proportional frequencies which were between the overall mean and one standard deviation above the mean were designated as "pertinent" to the preservice teacher. Categories with proportional frequencies which were between one and two standard deviations above the mean were designated as "important" to the preservice teacher. Categories with proportional frequencies which were more than two standard deviations above the mean were designated as "dominant" in the preservice teacher's thinking (Morine-Dershimer, 1984).

Figure 1

Information-Processing Model: Conceptual Framework for the Study

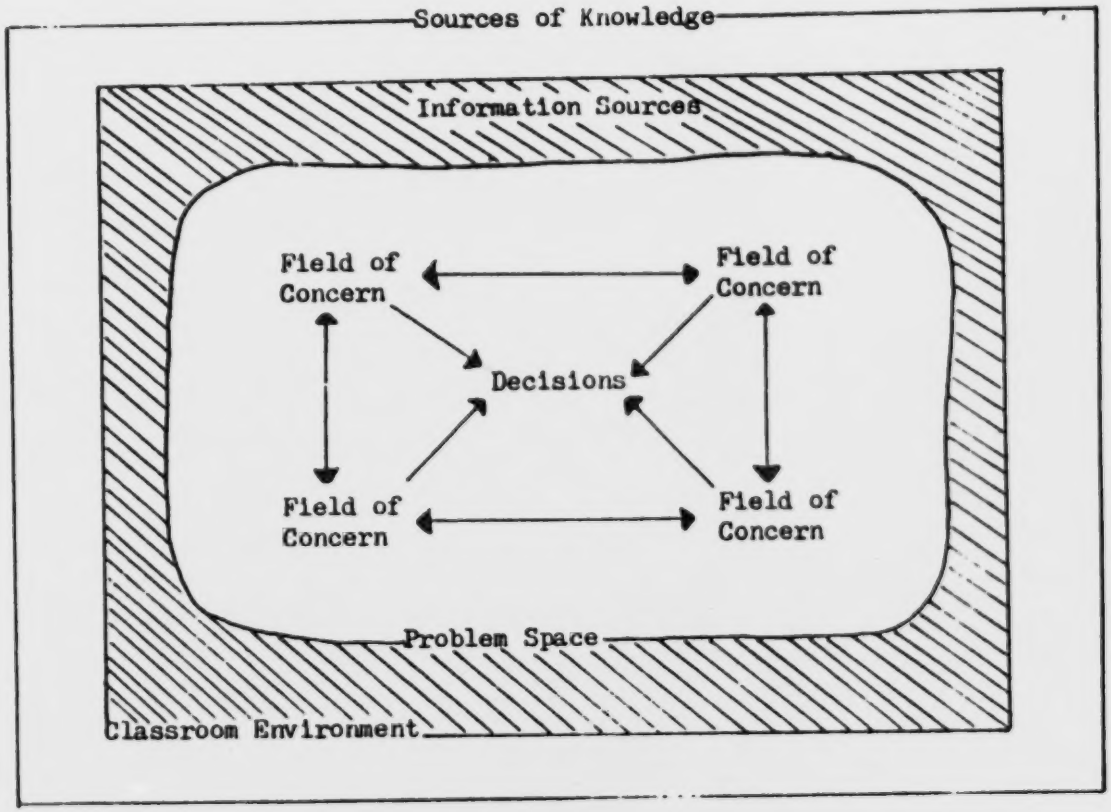


Table 1

Interactive Thoughts & Decisions of Preservice Teachers

(Mean Proportion of Events in Which Category was Mentioned)

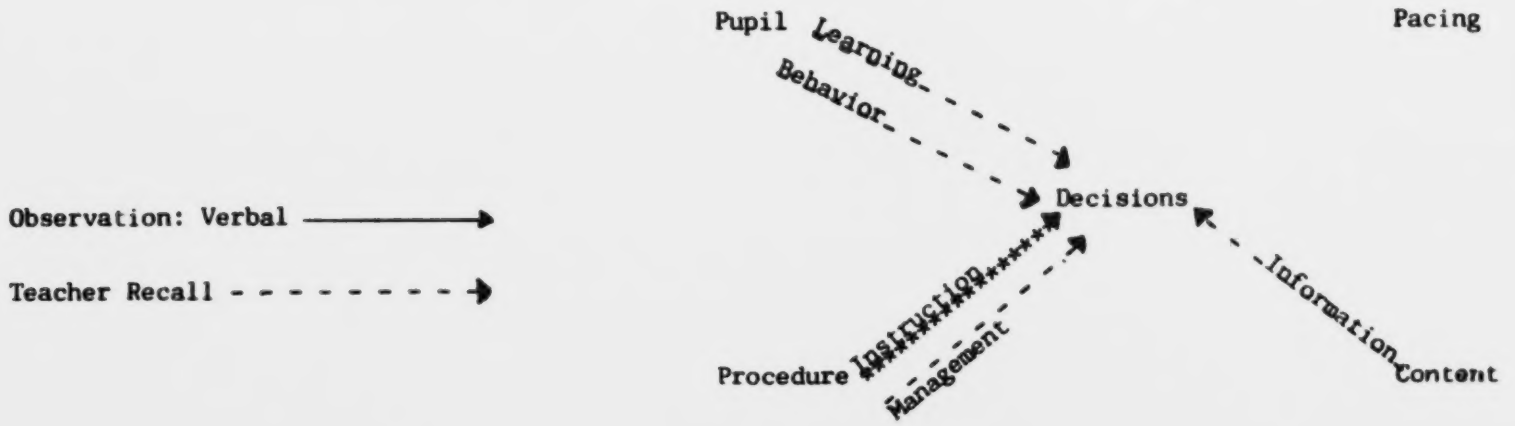
		Mean	SD
DECISION	Pupil-Related	.516***	.187
	Plan-Related	.248*	.128
	Supplementary	.013	.032
	Explanation of Events	.224*	.160
INSTRUCTIONAL CONCERN	Pupil Learning	.303*	.225
	Pupil Attitude	.101	.089
	Pupil Behavior	.230*	.193
	Content-Information	.225*	.164
	Content-Skill/Process	.156	.121
	Procedure-Instruction	.538***	.199
	Procedure-Control	.162	.098
	Procedure-Management	.217*	.136
	Pacing: Plan-Related	.184	.129
	Pacing: Pupil-Related	.107	.095
INFORMATION SOURCE	Observation: Verbal	.427**	.179
	Observation: Non-Verbal	.164	.106
	Teacher Expectation	.071	.085
	Teacher Hunch	.135	.108
	Teacher Recall	.289	.136
	Teacher Records/Notes	.095	.121
AWARENESS	Principles of Teaching	.046	.068
	Teacher Feelings	.122	.115
	Alternatives	.464**	.181
	Teacher Behavior	.021	.036
	OVERALL	.211	.149

Note. Since each event was coded for only one type of decision, the mean proportional frequencies add up to 100. Since multiple coding of the other categories was possible, the mean proportional frequencies do not add up to 100.

* = Pertinent Emphasis
** = Important Emphasis
*** = Dominant Emphasis

Figure 2

Information-Processing Model: Preservice Teachers



Note.

*****Dominant

———Important

- - -Pertinent

Table 2

Interactive Thoughts & Decisions by Major

(Mean Proportion of Events in Which Category was Mentioned)

		Elementary Mean (19.8)	Elementary SD (8.9)	Secondary Mean (21.8)	Secondary SD (8.6)
DECISION	Pupil-Related	.674***	.218	.426 **	.159
	Plan-Related	.185	.105	.291 *	.080
	Supplementary	.014	.034	.000	.000
	Explantion Events	.127	.142	.283 *	.122
INSTRUCTIONAL CONCERN	Pupil Learning	.326*	.313	.287 *	.204
	Pupil Attitude	.044	.042	.147	.088
	Pupil Behavior	.183	.121	.147	.098
	Content Information	.133	.097	.315 *	.188
	Content-Skill/Process	.146	.090	.075	.070
	Procedure Instruction	.566***	.279	.534***	.178
	Procedure Control	.163	.111	.119	.072
	Procedure Management	.182	.159	.197	.094
	Pacing: Plan	.112	.088	.263*	.103
	Pacing: Pupil	.158	.059	.077	.136
INFORMATION SOURCE	Observation: Verbal	.458**	.173	.361**	.218
	Observation: Non Verbal	.171	.118	.208	.141
	Teacher Expectation	.069	.098	.025	.039
	Teacher Hunch	.186	.147	.119	.109
	Teacher Recall	.259**	.089	.319 **	.202
	Teacher Notes	.080	.056	.059	.061
AWARENESS	Principles Teaching	.011	.027	.103	.093
	Teacher Feeling	.080	.069	.149	.146
	Alternatives	.561***	.229	.484**	.150
	Teacher Behavior	.008	.019	.063	.039

Note.

* = Pertinent Emphasis
** = Important Emphasis
*** = Dominant Emphasis

Figure 3

Instructional Concerns & Information Sources: Patterns of Emphasis for Elementary & Secondary Preservice Teachers

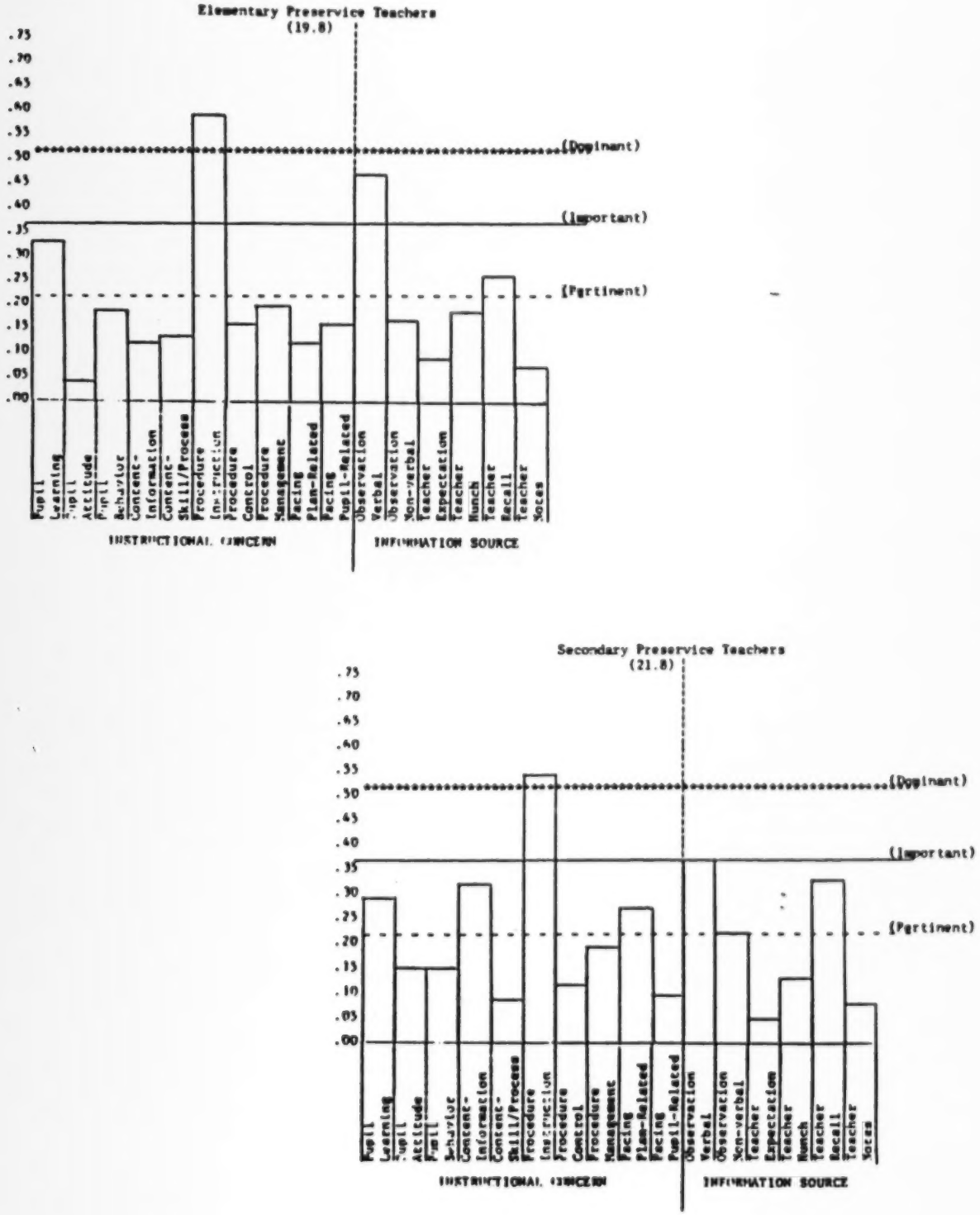
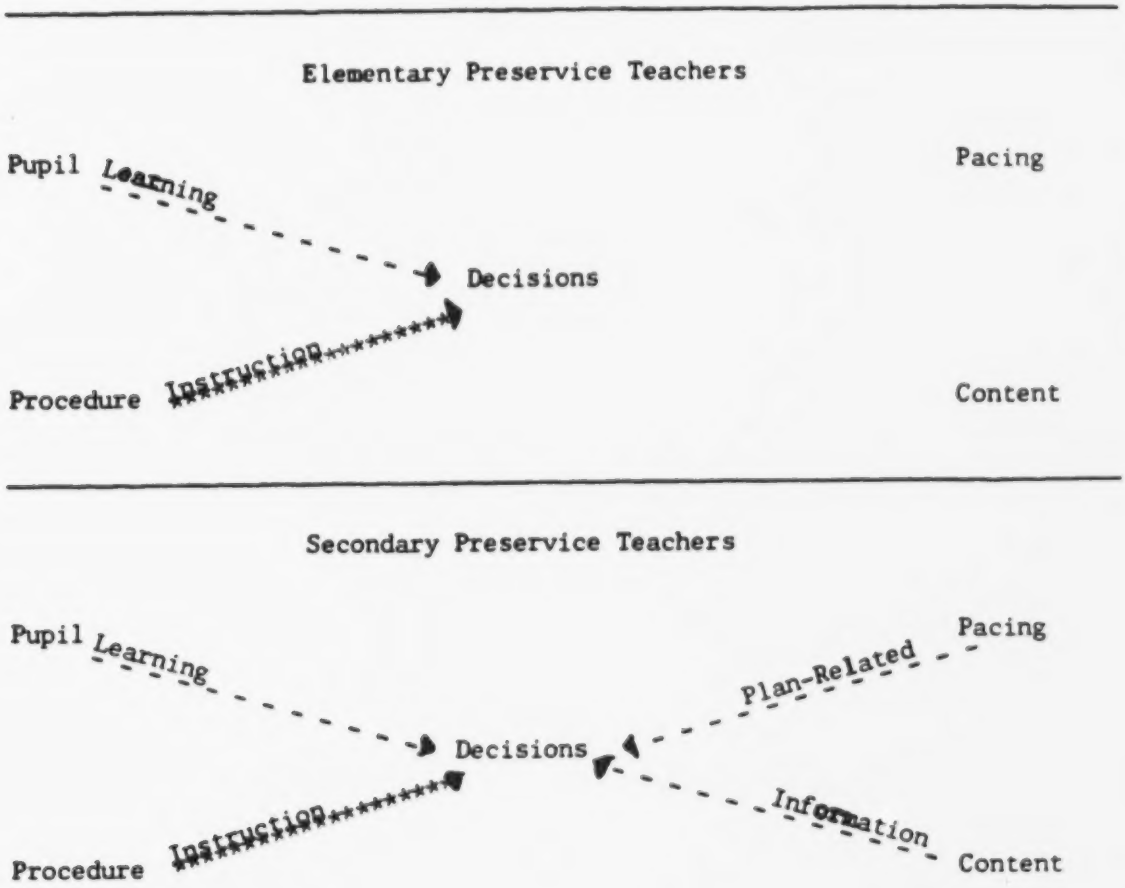


Figure 4

Information-Processing Model: Elementary and Secondary Preservice Teachers



Note.

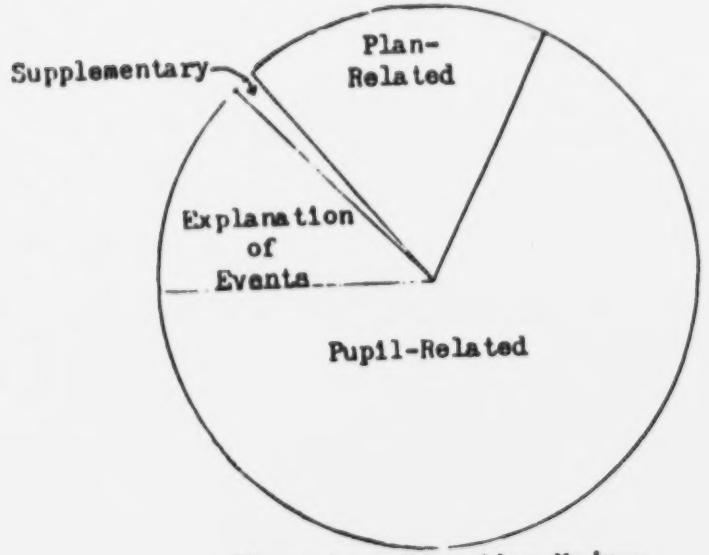
- - - = Pertinent

—— = Important

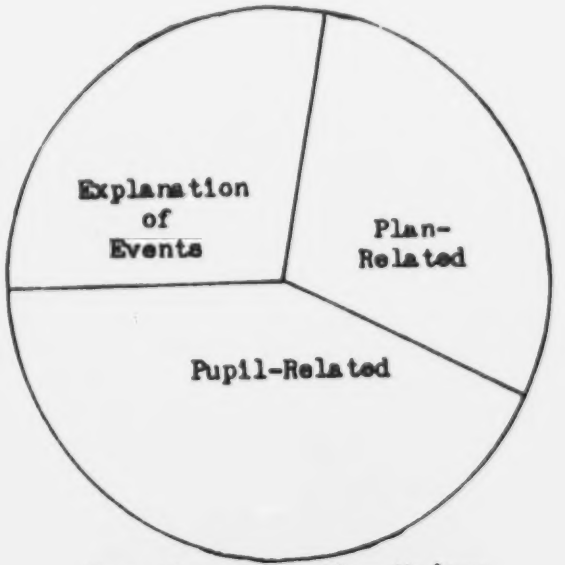
*** = Dominant

Figure 5

Types of Interactive Decisions By Major



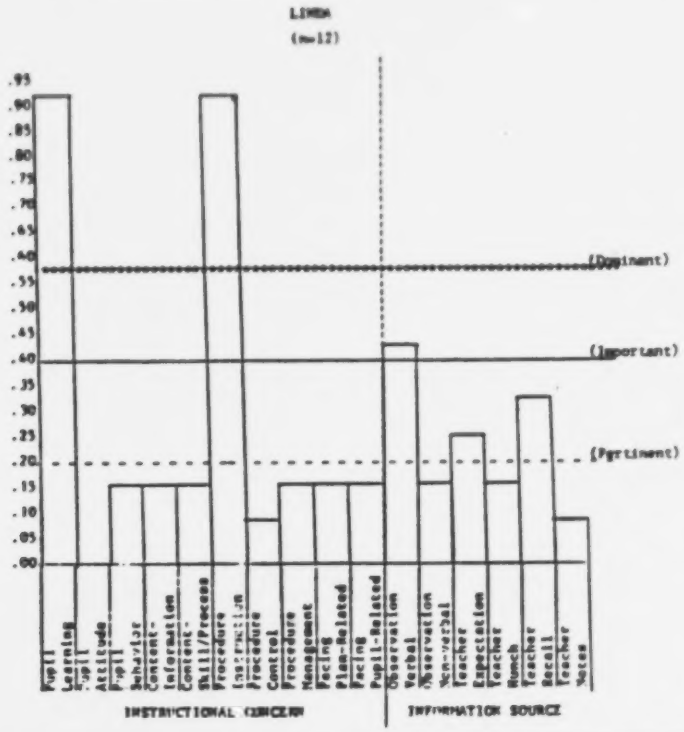
Elementary Education Majors



Secondary Education Majors

Figure 6

Instructional Concerns & Information Sources: Patterns of Emphasis



Information-Processing Model:

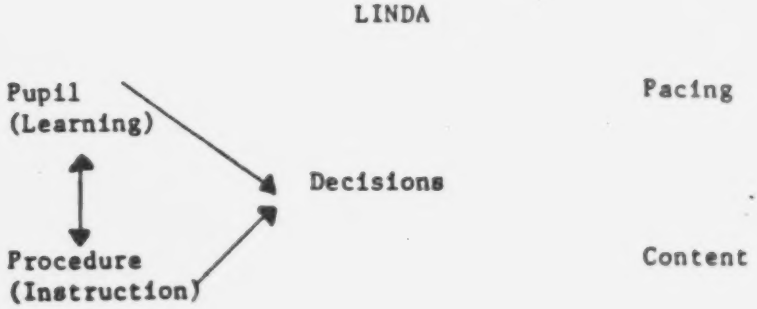
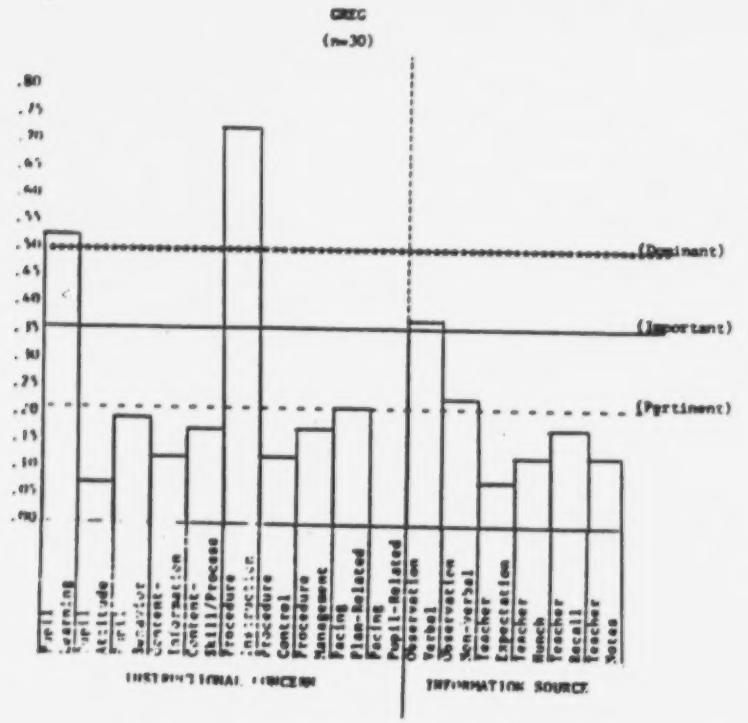
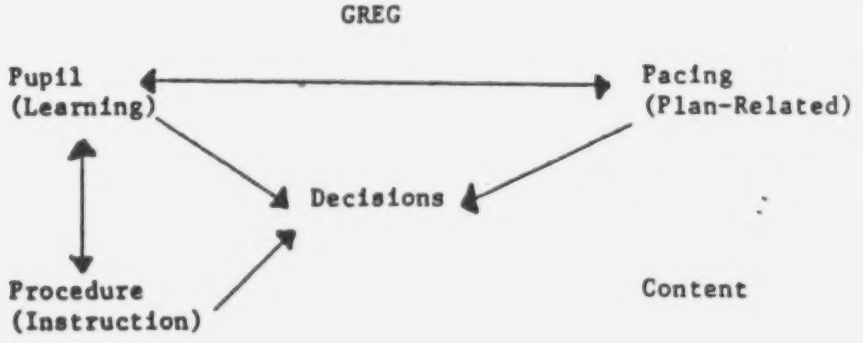


Figure 7

Instructional Concerns & Information Sources: Patterns of Emphasis



Information-Processing Model:



Appendix A

INTERVIEW PROCEDURE

Interviewer said:

I am interested in what you were thinking while you were teaching this lesson--especially what you were thinking as you decided what to do next at various points in the lesson. As I play back the lesson, please tell me to stop the tape whenever we reach a point where you were consciously saying to yourself, "Let's see, I think I'd better do this now," or "I guess I'll try doing this". I may stop the tape myself at a couple of points, but you should tell me to stop it whenever there is a point in the lesson where you made a specific decision about what to do next in the lesson. There are no right or wrong answers. I am interested in what you were thinking. Any questions?

When the subject stopped the tape, the interviewer asked:

1. What were you thinking at that point?
2. What did you notice that made you stop and think: (If necessary, add: Was there anything the pupils were doing that made you stop and think?)
3. Was there anything else you thought of doing at that point, but decided against?
4. What was it?

The interviewer stopped the tape at two points--

- when a pupil gave an incorrect answer to the preservice teacher's question and
- when the preservice teacher shifted activities in which pupils were engaged--

and continued with the prescribed questions given above.

Appendix B

Category System Used for Coding Stimulated Recall Protocols

General Explanation

This category system contains four major categories, each of which contains several sub-categories. The major categories are:

1. Decision Point: the kind of decision, or nondecision, that the teacher is reporting;
2. Concern:[1] the elements of instruction, management, or discipline that command the teacher's attention, i.e., that the teacher reports noticing;
3. Information Source: the types of input that the teacher indicates s/he is alert to during the lesson; and
4. Awareness: the varieties of cognitive and affective responses that the teacher mentions experiencing during the lesson.

Each time the videotape was stopped, the teacher's comments in the Phase One stimulated recall protocols were coded to indicate the type of decision point under discussion, the concern(s) mentioned, the information source(s) referred to, and the type(s) of awareness reported. While each stop was coded for only one type of decision point, multiple coding of the other categories was possible at each stop.

---

1. The term "concern" is used here in the sense of "matters that command attention," rather than in the sense of "worries."

The use of multiple coding, as described above, is illustrated below, with two examples. The sentence or phrase that determined the coding designation is presented in the context of the teacher's other comments, rather than in isolation, in order to give the reader a clearer idea of the application of this coding system.

1.

Decision Point: Plan-related	I had a whole section on women and I decided right then not to get off the track and so I kind of put it on a
Information Source: Observation Verbal	hanger. Jack picked up on the fact
Awareness: Teacher Feeling	that women don't have any rights. I was pleased with that. It showed at least that somebody was with me. I wanted to acknowledge it, but I didn't want to get off the track right then
Concern: Pacing: plan-related	because I knew we were coming back to it in a minute or two. If we
Awareness: Alternative	weren't going to come back to it for a day or two then I might have spent a little more time on it.

2.

Information Source: Observation: verbal	They were getting very wild. I heard them yelling, "Oh look, beautiful is right next to pretty" and I heard chairs going, desks moving and feet climbing up on chairs when I wrote the word on the
Decision: Pupil-related	board. So I decided that if they could they would get up and take over the class.
Concern: Procedure-Control	So I decided I had to stop it then before it got out of hand. No other alternative otherwise I would have been in big trouble.

Sub-category Definitions and Examples

In the section which follows, each sub-category is defined, and an example is given of a teacher comment that illustrates each sub-category.

DECISION POINT

Pupil-related: The characteristics or behavior of a pupil, a group of pupils or the class become the basis of the teacher's decision.
Example: "Okay, I decided not to pursue that. He had been a discipline problem and I've ignored him up to that point and I just couldn't ignore him any more. So I decided just not to discuss it with him, to leave it that you're seeing me for lunch."

Plan-related: Teacher reports a decision to behave in a particular way, based chiefly upon the original goals of the lesson.
Example: "That was an obvious decision. I didn't want to belabor the point and I did want to get to talking about Monolyn and Santiago because I think it is an important notion for this story and relevant to some other ideas."

Supplementary: Teacher reports a decision to include a topic or an activity that was not part of the original plan, based on unanticipated circumstances.
Example: "We'd already gone through the poem in about one half the time I thought it would take. So at that point I decided to go on and clarify the statements--they did some group work yesterday with a list of statements. I decided to review the statements with reference to the poem."

Explanation of Events: This is, technically, not a decision. The teacher simply explains what he/she was thinking or what was happening at that point in the lesson.
Example: "I was really pleased with that point. They caught on to what I was talking about...Sean asked a question and I said, 'Just a minute,' and they all waited. Sean got his question in. I answered it and then someone came out with the answer right away. I was really pleased that they stayed with me and they had thought about it and didn't get distracted, get off on a tangent."

CONCERN

Pupil Learning: The teacher attends to what the pupil(s) already knows or about recent pupil changes in knowledge, or about what pupil(s) does not yet know but may need to know.
Example: "I didn't want them to have that misconception so I went through the whole explanation of who she was instead of deciding to let it hang."

Pupil Attitude: The teacher's attention is on the feelings that pupils may be experiencing.
Example: "He needs some kind of reinforcement. He tried to tell Sean to shut up, or whatever. He feels really frustrated."

Pupil Behavior/Attention: Teacher comments on observations of pupils related to discipline or classroom management.
Example: "That class was out of hand. There were a lot of little conversations going on."

Content-Information: Teacher comments on the facts or concepts that are being covered in the lesson.
Example: "I wanted to make sure that they started thinking about this man and nature thing so I wrote it on the board."

Content-Skill/Process: This relates to teacher comments about the techniques or procedures that are being taught in the lesson and which pupils need to utilize in their work or practice.
Example: "I just wanted to remind them about what we want for these study guides."

Procedure-Instruction: The teacher's attention is on instructional routines being used in the lesson.
Example: "Conscious decision not to just let him off the hook. I pursued it with him even though I was thinking that I would have liked to have heard some other people's ideas."

Procedure-Management: The teacher's attention is on measures used to engage the pupils, keep them on task or get them involved in the lesson.
Example: "I knew the way to get their attention back would be to write on the board. They take that as a definite signal that they should be doing something."

Procedure-Control: This relates to measures used to discipline/control the behavior of the pupil(s).
Example: "That group over there was really a problem, a thorn in my side and I wanted to control them and I didn't very well. I got her and then I got Michelle to stay for lunch but there was still this undercurrent."

Pacing: pupil-related: Teacher comments on the timing of activities or speed of content coverage in a lesson, giving pupil characteristics or pupil responses as the principal reason for what is occuring.
Example: "At this point they're starting to get wound up. They're starting to get antsy and maybe it's time to start moving thing along, to keep up with the pace of some of them."

Pacing: plan-related: This is the timing of activities or speed of content coverage as planned by the teacher.
Example: "I didn't want to take the time. We have a lot to cover and it was a conscious or sub-conscious decision. We're behind and so I felt really pushed. We have to push on."

INFORMATION SOURCE

Observation: verbal: This relates to pupils' verbal behavior used as cues by the teacher.
Example: "He really lost me when he said, 'Does this mean I don't have to come for lunch.'"

Observation: non-verbal: These are cues inferred by the teacher from pupils' non-verbal behaviors like facial expression, posture or gesture.
Example: "I was noticing one girl waving her arm really frustrated."

Teacher Expectation: Pupils' behavior or learning which, because of his/her previous knowledge of the class or some other reason, the teacher expects in the course of the lesson.
Example: "I did repeat those two words on purpose because I thought that by just seeing those two words together, I expected them to almost immediately to be able to tell me that they are rhyming words."

Teacher Hunch: This refers to the assumptions or guesses that come to the teacher in the course of the lesson.
Example: "I get the impression that he gets my point that he should be paying attention and then I just call on somebody else."

Teacher Recall: This relates to references made, by the teacher, to previous information or event related to the present lesson content, procedure or the pupils.
Example: "We went through a listening exercise last week and I thought that had helped but it apparently didn't."

Teacher Records/Notes: This is a reference to information the teacher has previously prepared for the lesson and information recorded on the chalkboard.
Example: "On my clipboard were all my notes, my class notes, and I noticed that the microphone was sitting on top of my clipboard and I decided not to go and get those. I thought, oh well, I'm going to have to wing it with those little notes. Those were my preliminary notes. The real ones were underneath the microphone."

AWARENESS

Principles of Teaching: This refers to general rules that the teacher becomes mindful of and follows in a certain type of situation.
Example: "I have been trying very hard to wean them from total dependents on every note, every bit of information comes directly from the teacher and it just gets repeated and repeated."

Teacher Feelings: This refers to emotions the teacher experiences at a particular point in the lesson.
Example: "I was really frustrated because we had been through that song and dance before."

Alternatives: These are other techniques or procedures that the teacher becomes aware of which could be used in place of the one actually used in the lesson.
Example: "I decided not to give them a definition but rather to find out if they know another word for it."

Teacher Behavior: These are acts by the teacher, which seem to be more than the ordinary and of which s/he becomes aware.
Example: "I was thinking that I was standing more to the left of the classroom than to the right."

References

Abelson, R. P. (1976). Script processing in attitude formation and decision making. In J. S. Carol & J. W. Payne (Eds.), Cognition and social behavior. Hilladale, NJ: Lawrence Erlbaum.

Anderson, L., Evertson, C., & Brophy, J. (1979). An experimental study of effective teaching in first-grade reading groups. Elementary School Journal, 79, 193-223.

Borko, H. (1978, March). An examination of some factors contributing to teachers' pre-instructional classroom organization and management decisions. Paper presented at the annual meeting of the American Educational Research Association, Toronto, Ontario.

Brophy, J. E. (1980). Recent research on teaching (Occasional Paper No. 40). East Lansing, MI: Institute for Research on Teaching, Michigan State University.

Brophy, J. (1983). The teacher as thinker: Implementing instruction. In G. G. Duffy, L. R. Roehler, & J. Mason (Eds.), Comprehension instruction: Perspectives an suggestions (pp. 71-92). New York: Longman.

Chi, M. T. H., Glaser, R., & Rees, E. (1981). Expertise in problem solving (Technical Report No. 5). Pittsburg, PA: Learning Research and Development Center, University of Pittsburg.

Clark, C. (1978-1979). A new question for research on teaching. Education Research Quarterly, 3, 53-58.

Clark, C. M., & Peterson, P. L. (1984). Teachers' thought processes (Occasional Paper No. 72). East Lansing, MI: Institute for Research on Teaching, Michigan State University.

Connors, R. D. (1978). An analysis of teacher thought processes, beliefs and principles during instruction. Unpublished doctoral dissertation, Department of Elementary Education, University of Alberta, Canada.

Cooper, H. M., Burger, J. M., & Seymour, G. E. (1979). Classroom context and student ability as influences on teacher perceptions of classroom control. American Educational Research Journal, 16, 189-196.

Evertson, C., Anderson, C. Anderson, L., & Brophy, J. (1979). Relationships between classroom behaviors and student coutcomes in junior high mathematics and English classes. American Educational Research Journal, 17, 43-60.

Fogarty, J. L., Wang, M. C., & Creek, R. (1982, March). Descriptive study of experienced & novice teachers' interactive instructional decision making. Paper presented at the annual meeting of the American Educational Research Association, New York.

Fuller, F.F. (1969). Concerns of teachers: A developmental conceptualization. American Educational Research Journal, 6, 207-226.

Good, T., & Grouws, D. (1977). Teaching effects: A process-product study in fourth-grade mathematics classrooms. Journal of Teacher Education, 28, 49-54.

Good, T., & Grouws, D. (1979). The Missouri Mathematics Effectiveness Project: An experimental study in fourth-grade classrooms. Journal of Educational Psychology, 71, 355-362.

Jackson, P. W. (1968). Life in classrooms. New York: Holt, Rinehart & Winston.

Joyce, B. (1980). Toward a theory of information processing in teaching (Research Series No. 76). East Lansing, MI: Institute for Research on Teaching, Michigan State University.

MacKay, A. (1977). The Alberta studies of teaching: A quinquereme in search of some sailors. CSSE News, 3, 14-17.

MacKay, D. A., & Marland, P. (1978, February). Thought processes of teachers. Paper presented at the annual meeting of the American Educational Research Association, Chicago.

McNair, K., & Joyce, B. (1979). Teachers' thoughts while teaching: The South Bay study, Part II (Research Series No. 58). East Lansing, MI: Institute for Research on Teaching.

McNair, K., & Joyce, B. (1979). Teachers' thoughts while teaching: The South Bay study, Part II (Research Series No. 58). East Lansing, MI: Institute for Research on Teaching.

Medley, D. M. (1979). The effectiveness of teachers. In P. L. Peterson & H. J. Walber (Eds.), Research on teaching: Concepts, findings, and implications (pp. 11-27). Berkeley, CA: McCutchan Publishing Corporation.

Morine-Dershimer, G. (1979). Teacher plan and classroom reality: The South Bay study, Part IV (Research Series No. 60). East Lansing, MI: Institute for Research on Teaching, Michigan State University.

Morine-Dershimer, G. (1984, April). Complexity and imagery in teacher thought: Alternative analyses of stimulated recall data. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Morine-Dershimer, G., Coiro, M., Norton, R., Awua-Boateng, I., Devlin-Scherer, W., & Beyerbach, B. (1983, October). Instructional roles and perceptions of interactive teaching: Alternative analyses of stimulated recall data. Symposium conducted at the meeting of the Northeastern Education Research Association, Ellenville, NY.

Morine, G., & Vallance, E. (1975). Special study B: A study of teacher and pupil perceptions of classroom interaction (Technical Report 75-11-6). San Francisco, CA: Far West Laboratory for Education Research and Development.

National Institute of Education (1975). Teaching as clinical information processing (Report of Panel 6, National Conference on Studies in Teaching). Washington, D. C.: National Institute of Education.

Peterson, P., & Clark, C. M. (1978). Teachers' reports of their cognitive processes during teaching. American Educational Research Journal, 15, 555-565.

Schon, D. A. (1983). The reflective practitioner. New York: Basic Books, Inc.

Schwab, J. J. (1962). The concept of sturcture of a discipline. Educational Record, 43, 197-205.

Shavelson, R. J. (1972). Some aspects of the correspondence between content structure and cognitive structure in physics instruction. Journal of Educational Psychology, 63, 225-234.

Shavelson, R. J. (1973). What is THE basic teaching skill? Journal of Teacher Education, 24, 144-151.

Shavelson, R. J., Cadwell, J., & Izu, T. (1977). Teachers' sensitivity to the reliability of information in making pedagogical decisions. American Educational Research Journal, 14, 83-87.